

CHAPTER 10

DOCUMENTATION AND CHANGE CONTROL

10-1. General

Complete and accurate documentation is critical to the commissioning and ongoing maintenance and operation of a SCADA system and should be a high priority of design contract administration.

a. SCADA system documentation provided by the system designer and/or system integrator should include the following:

- (1) One-line diagrams
- (2) Process and instrumentation diagrams (P&IDs)
- (3) Sequences of operation
- (4) Instrument data sheets
- (5) Points list
- (6) Loop diagrams or I/O wiring diagrams
- (7) Binary logic diagrams
- (8) Control schematics
- (9) PLC program listing
- (10) HMI description (screen prints and database)
- (11) Software configuration management documentation
- (12) Facility physical and information security policies

b. All SCADA documentation should be furnished in both hard copy and appropriate electronic format. Electronic format should be capable of revision; i.e. scanned documents or portable document format (pdf) files are not acceptable, although pdfs may be submitted as archive copies in addition to revisable files.

c. All system documentation for C4ISR facilities should be treated as sensitive and this applies to SCADA system diagrams and documentation as well. At a minimum, document security measures should include:

- (1) Marking all documents For Official Use Only (FOUO)
- (2) Controlling access to documents
- (3) Properly destroying outdated or unused documents

10-2. Symbols and identification

Individual control loops should be identified by loop number following the convention established by ISA S5.1. Each instrument, actuator and control point should have a unique tag number incorporating the loop number and identification letters per table 1 of ISA S5.1. All equipment and instruments should be consistently identified by their complete tag number on all drawings and points lists.

10-3. Process and Instrumentation Diagram (P&ID)

P&IDs should be provided for all mechanical systems. P&IDs should depict all components of mechanical systems including vessels, pumps, compressors, chillers, heat exchangers, piping, valves and instruments and the control relationships between them. Symbols used should comply with ISA S5.1 - Instrumentation Symbols and Identification and ISA 5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.

10-4. Sequences of operation

Written sequences of operation should be provided for all control loops.

a. Sequences of operation should include the following minimum information:

- (1) Manual and automatic control modes;
- (2) Normal system conditions and modes of operation;
- (3) Contingency conditions and modes of operation;
- (4) Effect of all operator controls;
- (5) Description of all interlocks and permissives;
- (6) Identification of failure state of all outputs.

10-5. Instrument data sheets

Instrument data sheets should be provided per ISA S20

10-6. Points list

A points list should be provided that includes all real and virtual input, output and control points.

a. Provide the following information, where applicable, for each point:

- (1) System
- (2) Equipment
- (3) Loop number
- (4) Tag number

- (5) Controller, rack and slot
- (6) Point type
- (7) Field location
- (8) Range
- (9) Failure state

b. A points list is located in appendix D.

10-7. Loop diagrams

Loop diagrams define the physical wiring for each loop from each instrument or actuator to the controller. All field devices, terminal boards, junction boxes, etc. are depicted along with the signal type and range. These drawings are the basis for verification of all SCADA system field wiring, instrument calibration, and loop tuning. All devices, terminals, cables and conductors must be completely identified on the loop diagrams per ISA S5.4 – Instrument Loop Diagrams. A loop diagram is located on page D-2.

10-8. Binary logic diagrams

Binary logic diagrams are flowcharts that depict all discrete logic using Boolean logic symbols. Logic diagrams should comply with ISA S5.3 – Binary Logic Diagrams. A binary logic diagram is located on page D-3.

10-9. Control schematics

Control schematics show the interface between the SCADA system and the internal wiring of related equipment such as motor starters, pump control panels, generator control panels, etc. Proper development of control schematics requires a significant effort on the part of the SCADA system integrator because the standard drawings provided by manufacturers of these related system drawings are typically inconsistent in format, symbols and content, requiring that they be redrafted by the integrator to provide an integrated documentation package. Symbols used on control schematics should comply with the previously referenced ISA standards and ANSI Y14.15. – Electrical and Electronic Diagrams.

10-10. PLC program listing

A documented listing of the complete program of each PLC should be provided. Documentation should consist of an English-language description of the function of each logic rung inserted into the listing.

10-11. Change control

All SCADA documentation should include creation date, issue date, revision data, and revision history in a format that is consistent across all documents. A document database or spreadsheet should be maintained that provides a current listing of all documents and their revision status.

a. The database should include the following:

- (1) Document Type

- (2) Document Number
- (3) Page Number
- (4) Sheet Number
- (5) Title
- (6) Current Revision
- (7) Revision Date

b. Each submittal of SCADA documentation should include an updated submittal of the document database. The database should be provided in electronic format and maintained on an ongoing basis by the facility manager after system commissioning. All changes made to the system should be promptly reflected by revising the documentation and the database and distributing copies of the revised documentation and updated database to the field.